HACKING WITH SWIFT

HACKING WITH macOS

SWIFTUI EDITION

Learn to make deskto
apps with real-wo
Swift projects

FREE SAMPLE

Paul Hudson

Project 1
Storm Viewer

Get started coding in Swift by making an image viewer app and learning key concepts.

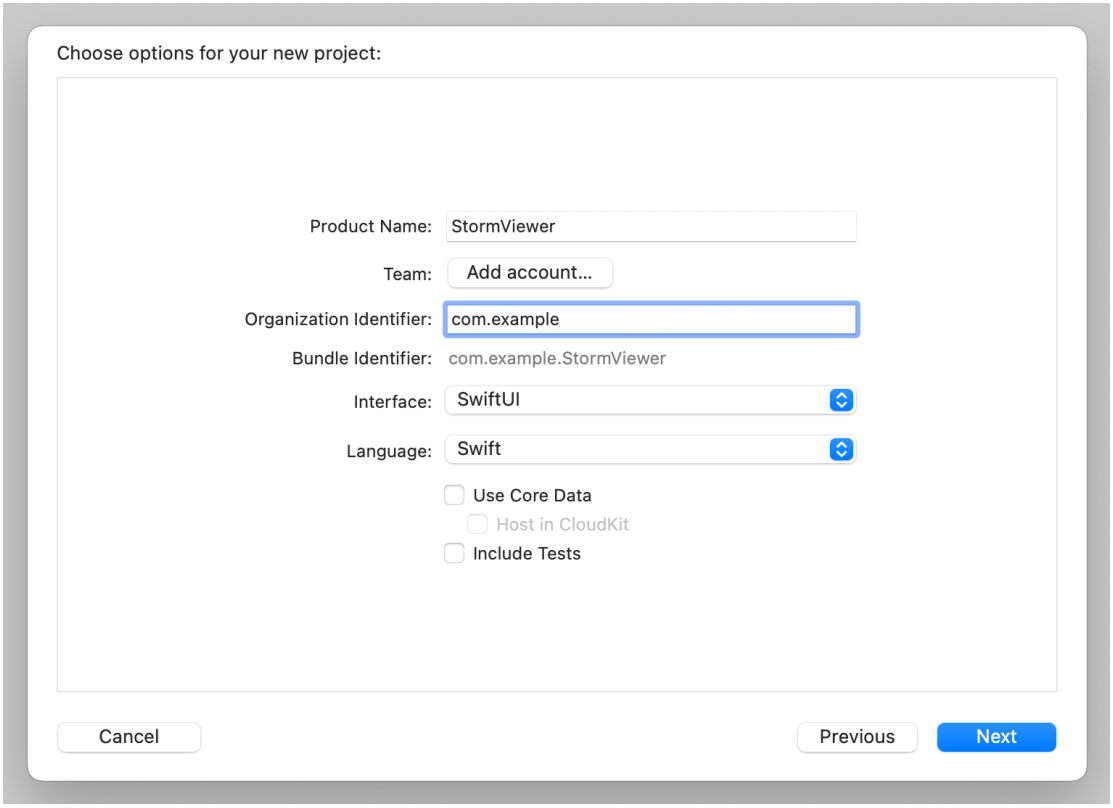
Storm Viewer: Setting up

In this project you'll produce an application that lets users scroll through a list of images, then select one to view. It's deliberately simple, because there are many other things you'll need to learn along the way, so strap yourself in – this is going to be long!

Let’s get started: launch Xcode, and choose "Create a new project" from the welcome screen. You’ll be asked to choose a template for the new project, so please choose macOS > App, then click Next.

For Product Name enter StormViewer, then make sure you have Swift selected for language and SwiftUI for interface. This screen contains some checkboxes that affect what kind of template you’re given. None of the projects in this book use these features, so leave them all unchecked.

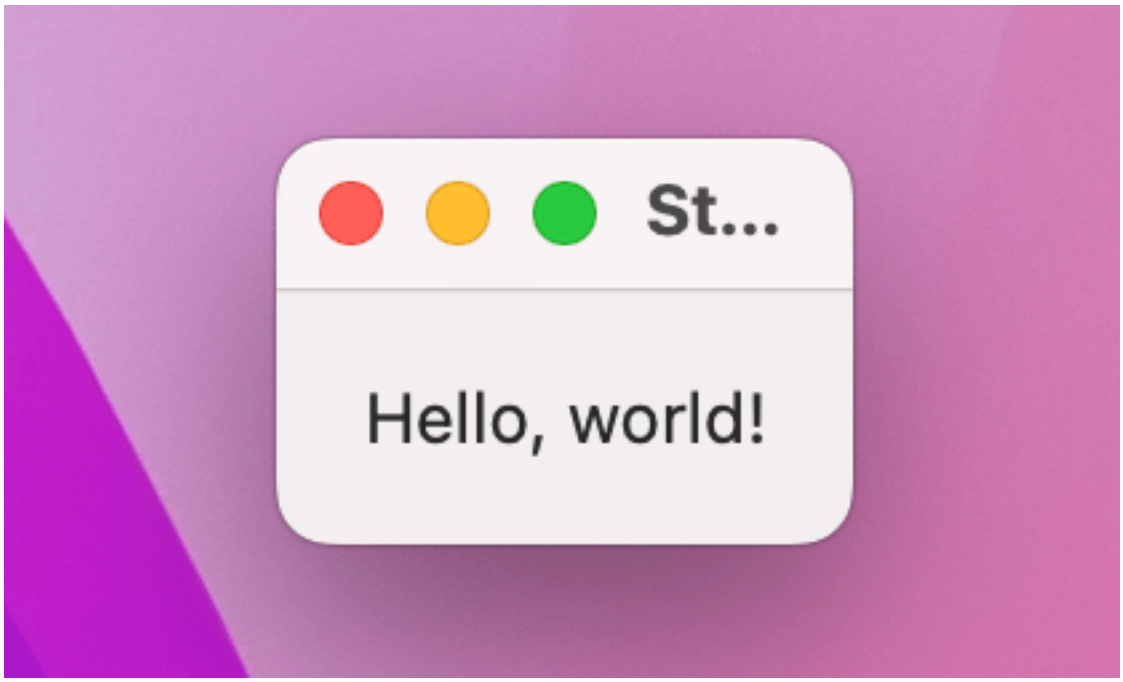
One of the fields you'll be asked for is "Organization Identifier", which is a unique identifier usually made up of your personal website domain name in reverse. For example, I would use **com.hackingwithswift** if I were making an app. You'll need to put something valid in there if you're deploying to devices, but otherwise you can just use **com.example**.



Now click Next again and you'll be asked where you want to save the project – your desktop is fine. Once that's done, you'll be presented with the example project that Xcode made for you.

The first thing we need to do is make sure you have everything set up correctly, and that means running the project as-is: look for the Play triangle button near the top-left of the Xcode window, and click it now. This will compile your code, which is the process of converting it to instructions that your computer can understand, then launch the app.

As you'll see when you interact with the app, our “app” just shows a small window saying “Hello, world!” – it does nothing at all, at least not yet. You can’t resize it much, but you can move it around, minimize it, or even make it full screen.



You'll be starting and stopping projects a lot as you learn, so there are three basic tips you need to know:

- You can run your project by pressing Cmd+R. This is equivalent to clicking the play button.
- You can stop a running project by pressing Cmd+. when Xcode is selected.
- If you have made changes to a running project, just press Cmd+R again. Xcode will prompt you to stop the current run before starting another. Make sure you check the "Do not show this message again" box to avoid being bothered in the future.

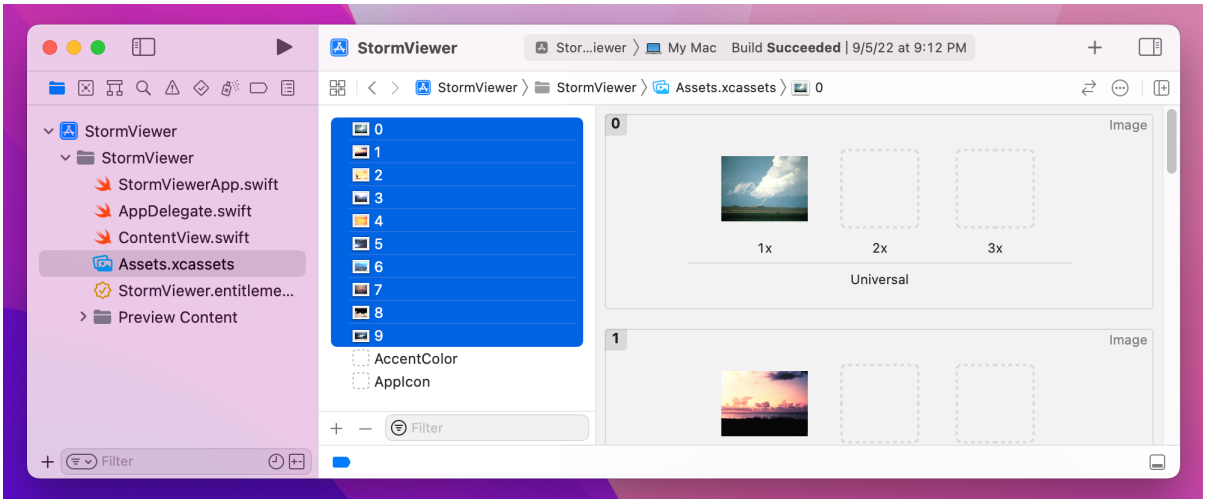
This project is all about letting users select images to view, so you're going to need to import some pictures. You should have downloaded the project files for this book already, but if you haven't please get them from here: **https://github.com/twostraws/macOS**

If you look in the project1-files directory you'll see the collection of JPEG files that we'll be using for this project. These need to be copied into your project, but in a very precise way thanks to the way macOS handles image assets.

On the left of your Xcode window you'll see a list of files in your project, one of which is

called “Assets.xcassets”. This is your *asset catalog*, which is where you need to store all the images you want to use in your project. When Xcode builds the project this asset catalog is automatically built too, and it optimizes the images for maximum performance when you deploy through the App Store.

Select the asset catalog now, and you should see a couple of placeholder assets like “AppIcon” and “AccentColor”. I’d like you to drag all 10 image assets from Finder into the asset catalog now, which means they are ready for us to use in the project.



Working with views

Now that we have some data to work with, I want you to open ContentView.swift so we can start using it. This file is the default in all SwiftUI projects on all platforms, and provides a simple SwiftUI layout that produces the "Hello, world!" text you saw earlier.

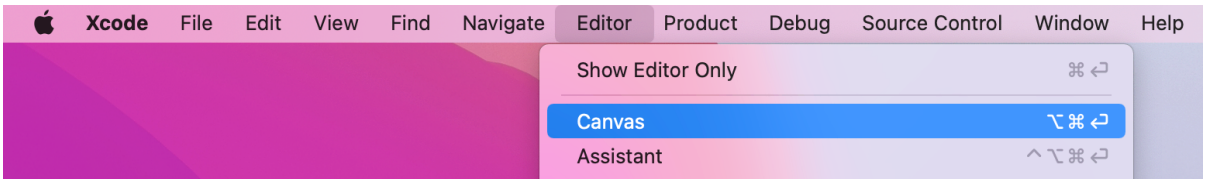
You should see something like this:

```
struct ContentView: View {
  var body: some View {
    Text("Hello, world!")
      .padding()
  }
}
```

There are lots of small but important things in there, so let me break it down quickly:

1. It defines a new struct called **ContentView**. All our SwiftUI layouts are structs because behind the scenes these are simpler and faster for the system to create and manage.
2. This struct conforms to the **View** protocol. In SwiftUI anything that renders content must conform to the **View** protocol so that it can tell SwiftUI what it draws.
3. The struct has a computed property called **body**, which is the only requirement of the **View** protocol. This is where you create your layouts.
4. As you can see, this has the return value **some View**, which means "this view will itself return some sort of views" – it might be images, text, sliders, buttons, and so on, but ultimately every view must return something to draw.
5. In this case our body contains only one thing, which is a **Text** view with the string "Hello, World!"
6. After the text view is a method call, **padding()**, which adds some spacing around a view so that other views don't butt up directly against it. In SwiftUI we call this a *modifier*, because it modifies the way the text view looks. It's common to have many modifiers stacked up for a single view.

Below that view struct is more code that creates a preview of your view, and is designed to show you a live preview of your layouts while you work – that's the canvas on the right of your code. You can show or hide this canvas by going to the Editor menu and clicking Canvas.



Over time you'll learn more about how these work and what their subtleties are, but for now you know enough to continue.

Now, in this app we're going to show a list of pictures for the user to choose from, then show individual pictures zoomed large when one is chosen. This split approach is a very common layout on macOS: you see it in Finder, in iTunes, in Keynote, and even in Xcode, so it makes sense to tackle it first.

In SwiftUI, we can get this horizontal split behavior using a new view type called **HSplitView**. When you place one of these, you can go ahead and add two child views to represent the left and right side of your split.

So, we might start with something like this:

```
struct ContentView: View {
  var body: some View {
    HSplitView {
      Text("Left")
      Text("Right")
    }
  }
}
```

That creates the **HSplitView** with Left and Right text views inside. If you run the app you'll see both text views should appear, although it's not really apparent what the split view is actually adding here.

You see, on macOS SwiftUI tries to size windows based on the size of its *content*, and in our case that means our window size won't be allowed to grow any larger than the space required to show the two text views. It won't *always* do this because some views are happy to resize upwards, but text very strongly prefers to grow no bigger than needed, causing our window to be tiny.

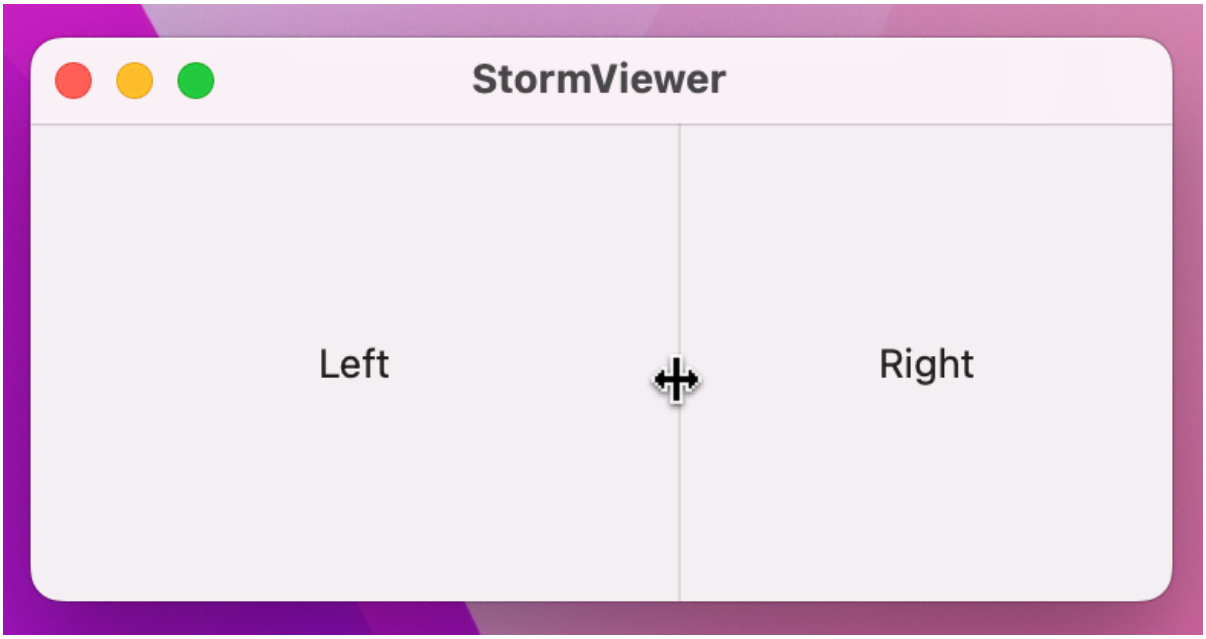
To make things significantly better, we're going to add a modifier to each of those text views called **frame()**. You already met the **padding()** modifier, which adds a fixed amount of space around a view, but **frame()** lets us provide rules for how big each view should be. Sometimes these rules are fixed – "I want this text view to be exactly 200 points wide", for example, but you can also provide minimum and maximum values to allow for flexibility.

Here we're going to make both our text views have completely flexible width and height – modify your code to this:

```
HSplitView {
  Text("Left")
```

```
        .frame(maxWidth: .infinity, maxHeight: .infinity)

    Text("Right")
        .frame(maxWidth: .infinity, maxHeight: .infinity)
}
```



And now when you run the app again things should look a lot better because you can resize the window freely. More importantly, you can also look for and drag the splitter pane that divides the two pieces of text, to adjust how much space each side gets inside the window.

Introduction to lists

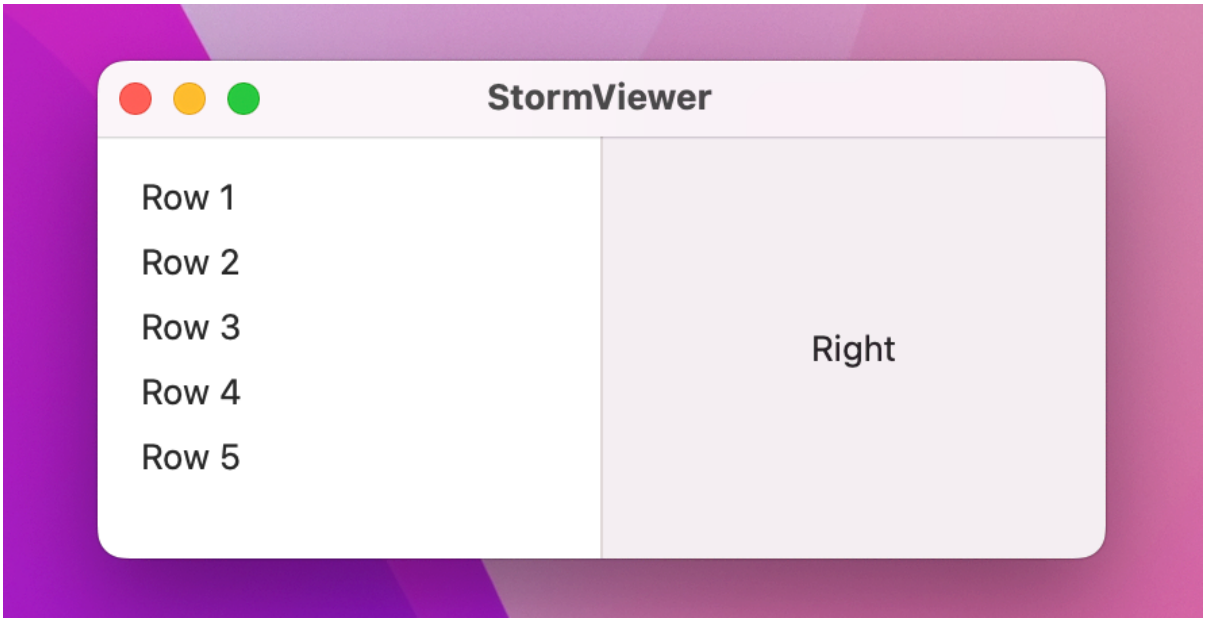
All our work so far has led to something that looks only fractionally different from the gray window we had straight out of the Xcode template. However, things are about to get a bit more interesting: we're going to start showing some dynamic information in our user interface.

We're going to start with the left-hand pane of our split view first. This is going to contain a list of pictures for the user to choose from, and in SwiftUI that's handled by a component called **List**.

Lists can work with a fixed range of data for times when you want to display static data, they can use ranges when you need to repeat something multiple times, or they can use wholly dynamic data such as a list of student names in a classroom.

Let's try each of those out there so you can see how they work, starting with static data. Replace your "Left" text view and its **frame()** modifier with this:

```
List {
  Text("Row 1")
  Text("Row 2")
  Text("Row 3")
  Text("Row 4")
  Text("Row 5")
}
```



Unlike **Text**, **List** doesn't need a **frame()** modifier because it automatically resizes to take up all the available space.

Now let's try recreating the same list using a range:

```
List(1..<6) { number in
  Text("Row \(number)")
}
```

What's happening here is quite complex behind the scenes: **List** takes a closure as its last parameter, which will be called once for every row in the list and is our chance to decide what should go in each row – that's what the **number in** is telling us.

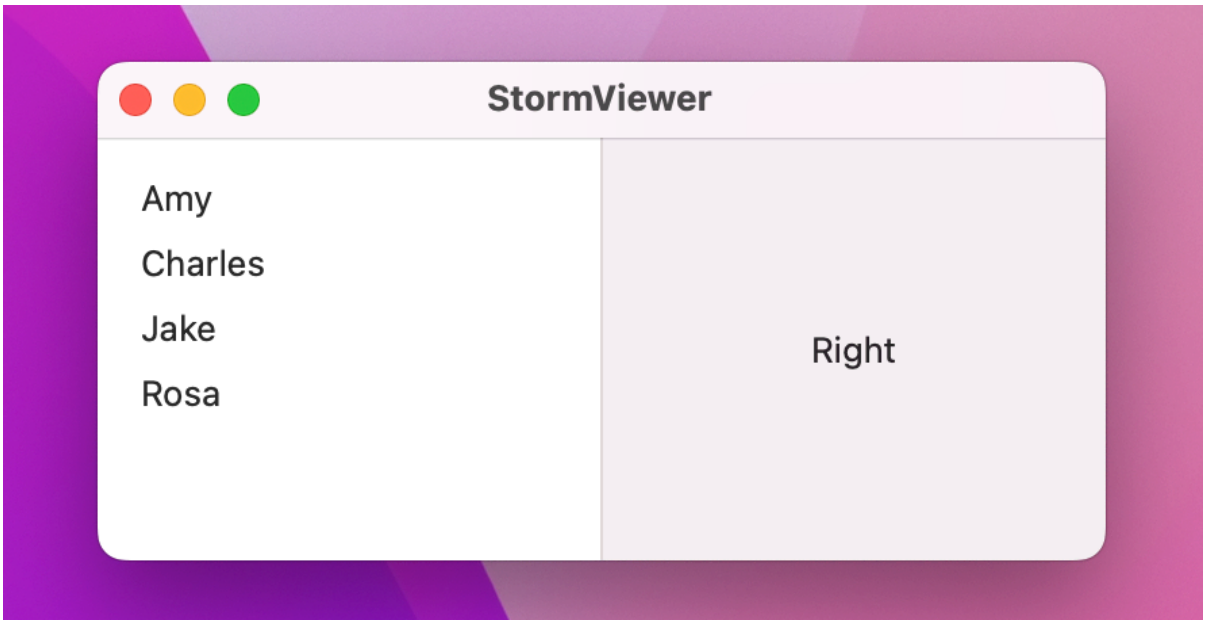
When that new code runs it will produce exactly the same list as the static version, except obviously it's a lot less code!

Let's look at the third example now: displaying names from an array. First, add this new property to the **ContentView** struct:

```
let names = ["Amy", "Charles", "Jake", "Rosa"]
```

Now change your **List** code to this:

```
List(names, id: \.self) { name in
  Text(name)
}
```



That's a bit similar to the range **List**, but there's an important change: **id: \.self**. This is important, and in fact it's so important it deserves some bold:

This is important.

When we create fixed views – when we type **HSplitView** with a **List** inside, then some **Text**, etc – SwiftUI can see at compile time exactly how our view hierarchy looks, which means it knows exactly which views are where.

In comparison, when we create *dynamic views* – when we loop over an array, for example – then SwiftUI doesn't have all the information at compile time, it just knows there will be some number of views being laid out when the code runs.

In order to make sure all its animations work correctly, so that it can insert new rows in the list if a new name got added at runtime for example, SwiftUI needs to know how to identify each

dynamic view uniquely. In the future I'll show you how to create unique identifiers for your data, but here we have a simple array of strings – the only thing about each string that makes it unique is the string itself.

So, when we say **List(names, id: \.self)** we're telling SwiftUI to create one row in our list for each of the names, and to give each of those rows the identifier of the name itself. With that in place, SwiftUI can now identify each part of our view hierarchy uniquely, which is exactly what it wants.

Note: By using **\.self** for the identifier, we've told SwiftUI that every one of our strings *will* be unique. If you try to add multiple instances of the same name it will almost certainly lead to problems in the future.

Each of those three ways of creating a list is important, and you'll definitely be using all three extensively in the future.

You'll also find you can combine them – you can create some rows as static, then loop over some dynamic data, then create some more static rows, and so on. This is made possible through a special view type called **ForEach**, which works much like the dynamic **List**: provide it with an array of data to loop over, along with an identifier so it knows what makes each item unique, plus a function to run for each item.

For example, we could mix static and dynamic data like this:

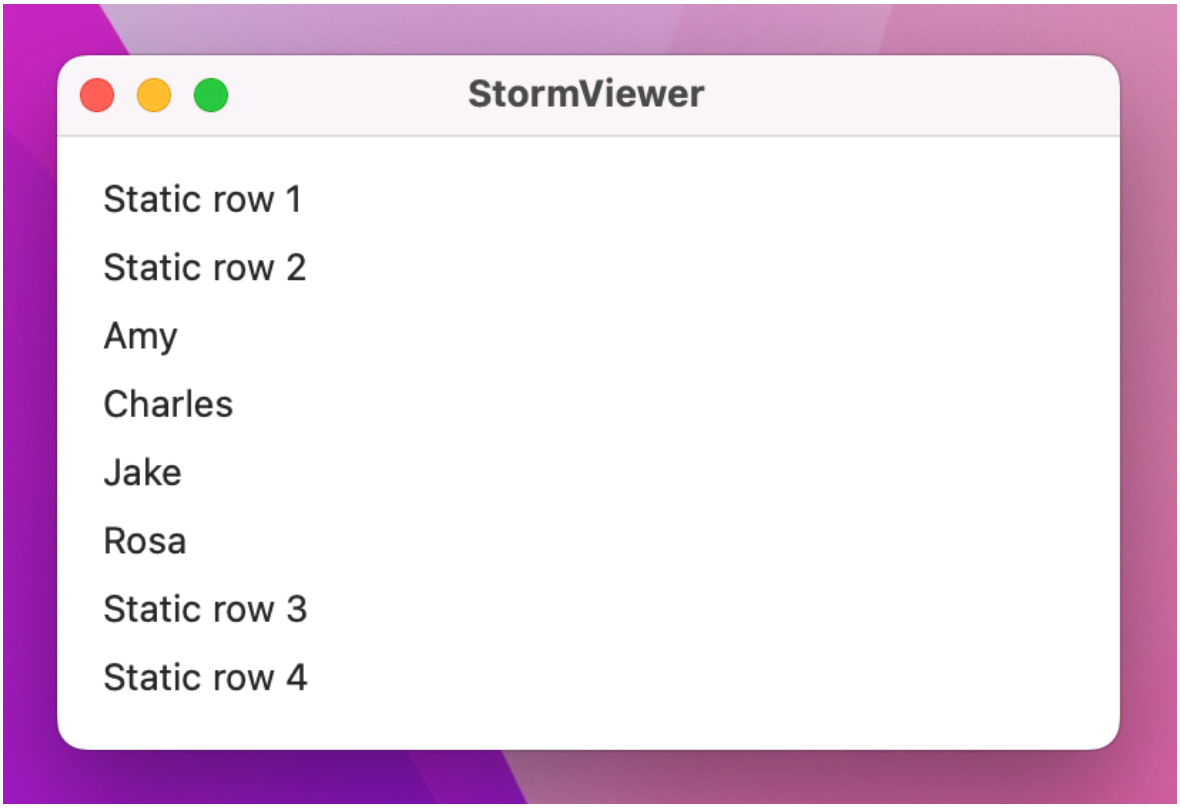
```
struct ContentView: View {
  let names = ["Amy", "Charles", "Jake", "Rosa"]

  var body: some View {
    List {
      Text("Static row 1")
      Text("Static row 2")

      ForEach(names, id: \.self) { name in
        Text(name)
```

```
        }

        Text("Static row 3")
        Text("Static row 4")
    }
  }
}
```



You'll find **ForEach** is useful in lots of other places where you want to repeatedly create views – more on that later!

Loading our images

When you set up this project you should have copied the image assets I provided for you into your asset catalog. Well, now it's time to put them to use and show them inside our list.

You've already seen how **List** can be created using a range, and because our images are numbered 1 through 10 we can use exactly that approach to show them all.

Replace your existing **List** code with this:

```
List(0..<10) { number in
  Text("Storm \(number + 1)")
}
```

That will show 10 rows, one for each storm file we added. If you run the app now you'll see them all, but you'll also notice you can't actually select any of the rows – this is because we haven't told SwiftUI that selection is even possible.

There's a saying among SwiftUI developers that our "views are a function of their state," but while that's only a handful of words it might be quite meaningless to you at first.

If you were playing a fighting game, you might have lost a few lives, scored some points, collected some treasure, and perhaps picked up some powerful weapons. In programming, we call these things *state* – the active collection of settings that describe how the game is right now.

When we say SwiftUI's views are a function of their state, we mean that the way your user interface looks – the things people can see and what they can interact with – are determined by the state of your program. For example, they can't click Continue until they have entered their name in a text field.

Because program state directly affects what's shown in your user interface, SwiftUI needs to know exactly what state you're working with so it can watch for changes and update things as needed. This is all done using a *property wrapper*, which is an extra piece of code that sits

around any one of your properties to add bonus functionality – in this case it's functionality that lets SwiftUI watch for changes and update your view whenever the view changes.

In this program we need some state to track which row is currently selected, so add this now:

```
@State private var selectedImage: Int?
```

That does several things all in one, so let's break it down:

1. The **@State** property wrapper marks a piece of program state that we want to change as our program runs.
2. This particular property wrapper is used for *local* state – state that only this view uses – so we've marked it as **private** to re-enforce that.
3. The property is called **selectedImage**, which makes sense because it will track the image number that is selected.
4. It's an integer, because it will track the image number.
5. That integer is *optional*, because it's possible for the user to click on nothing and thus deselect their image.
6. The integer has no default value, which means no image will be selected by default.

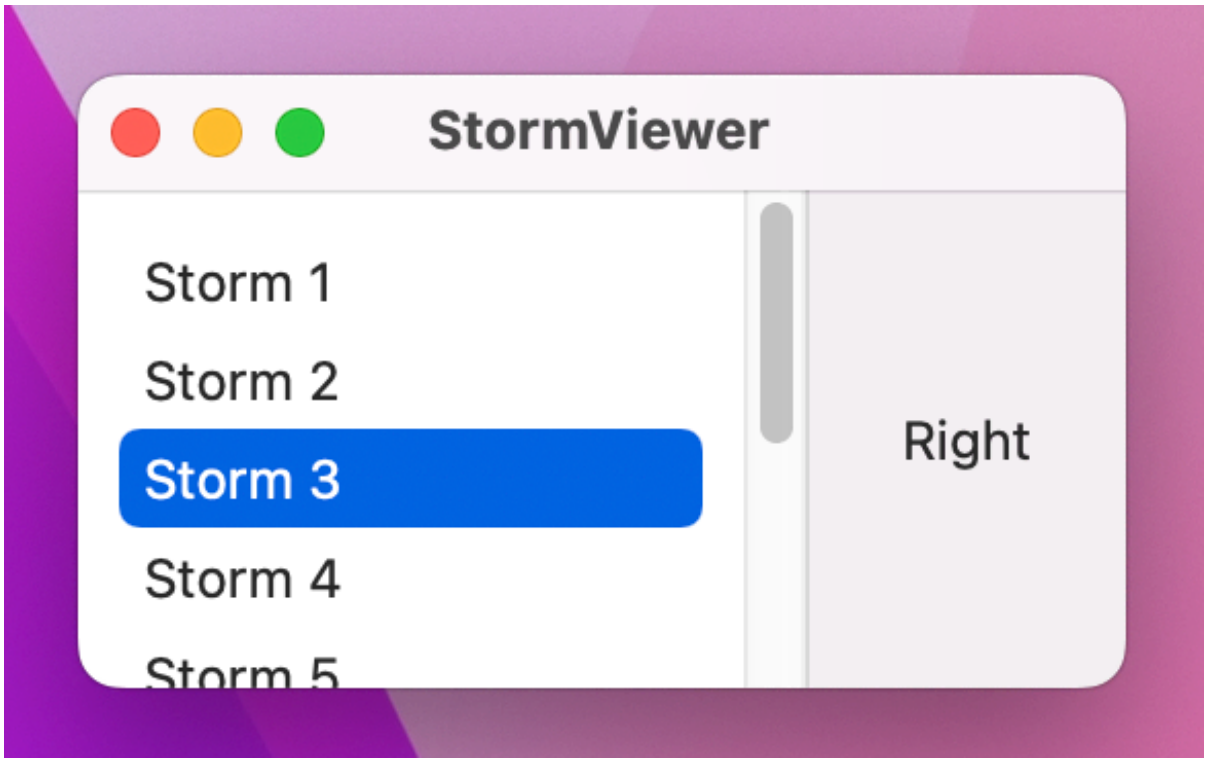
Just adding the new property isn't enough to attach it to our **List**, though. For that we need another important feature of SwiftUI: two-way bindings.

Two-way bindings allow information to flow in two ways: from our property to the user interface, or from the user interface back to the property. In the case of our list, that means changing our property using something like **selectedImage = 5** will cause the selected row to change in the UI as well, but also that clicking on a different row in the UI will cause the property's value to be updated.

Two-way bindings in SwiftUI are marked with dollar signs before their property names, so let's go ahead and bind the selection of our list to the **selectedImage** property – change your **List** code to this:

```
List(0..<10, selection: $selectedImage) { number in
```

If you run the app now you'll see things are moving on, because you can now select any of the rows to have them be highlighted, or click on some empty space on the list to deselect them all.



Responding to image selection

Believe it or not, this project is almost finished! The last step is to respond to the user selecting a picture in the list and showing the relevant image in the right-hand pane of our split view.

Making this work means meeting another new SwiftUI view, along with two new modifiers. However, along the way you'll get a much better idea of how SwiftUI responds to state changes, and why it makes our life so much easier.

Right now the right-hand side of our split view just says "Right", but really that needs to say something more sensible – that text will be shown when the app first runs, before the user has selected any image, so a little prompt is much more useful.

Change it to this:

```
Text("Please select an image")
  .frame(maxWidth: .infinity, maxHeight: .infinity)
```

Now for the important part: when the user *does* select an image, we need to replace that text with the actual image they chose. This can be done with SwiftUI's **Image** view, but the real question is how we know which to show – the image or the text.

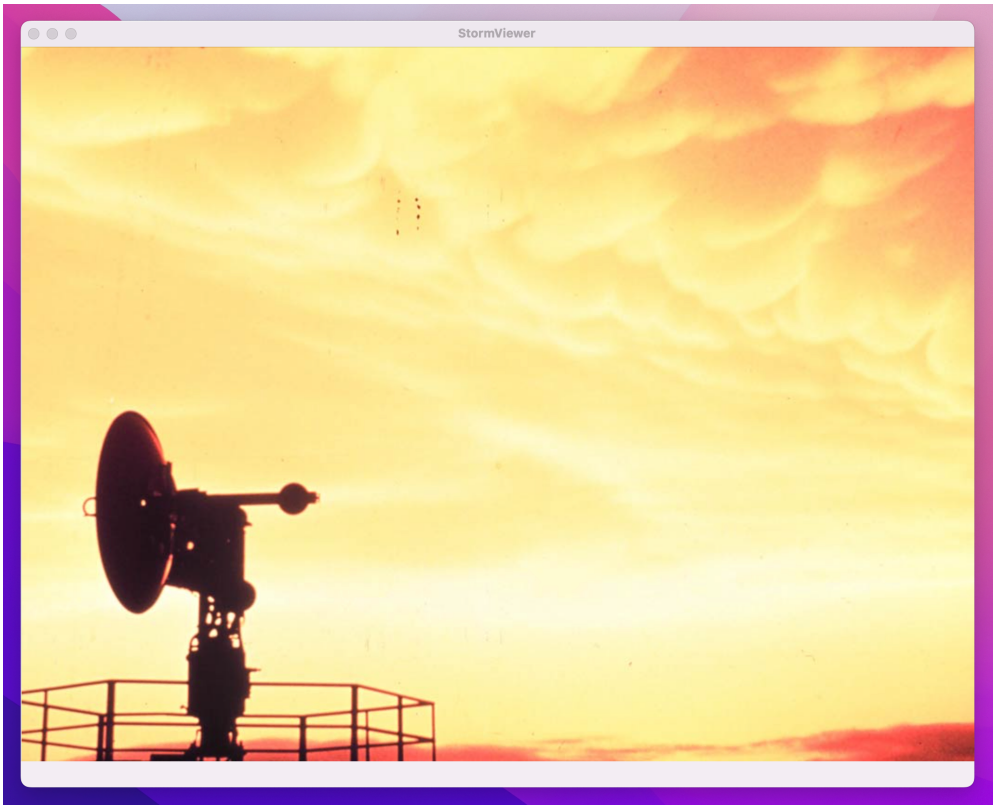
Well, our **selectedImage** property is an optional integer, so the answer here is straightforward: if we can read a value from that property then we should be showing the image, otherwise we should be showing the text. This can be done with **if let** to unwrap the optional safely, so put this around your current **Text** prompt:

```
if let selectedImage = selectedImage {
  Image(String(selectedImage))
} else {
  // "Please select an image" text
}
```

Our **selectedImage** property is an integer, but SwiftUI's **Image** view wants an asset *name* to

load, so we need to convert that integer to a string. When that code runs SwiftUI will automatically look in the asset catalog for a file matching our selected number – it ignores any file extension, which means loading 1 will load our 1.png picture.

If you run the app now you'll see something quite surprising happens: when you select a picture, the size of your window will jump to something quite different, and it's possible the whole list on the left of the split view will disappear.



This happens for the same reason our original "Hello, world!" window was so small: SwiftUI will automatically adjust its user interface to fit the size of its content. In this case our **List** has a flexible width and height by default, but the new **Image** that gets shown has a fixed size of whatever dimensions the image file has. So, when SwiftUI has to show the image it will first reduce the amount of space allocated to the **List** so that it can show more of the image, but when it runs out of space there it will just make the window larger.

This isn't a great result: making the list disappear is a pretty grim user experience, but then

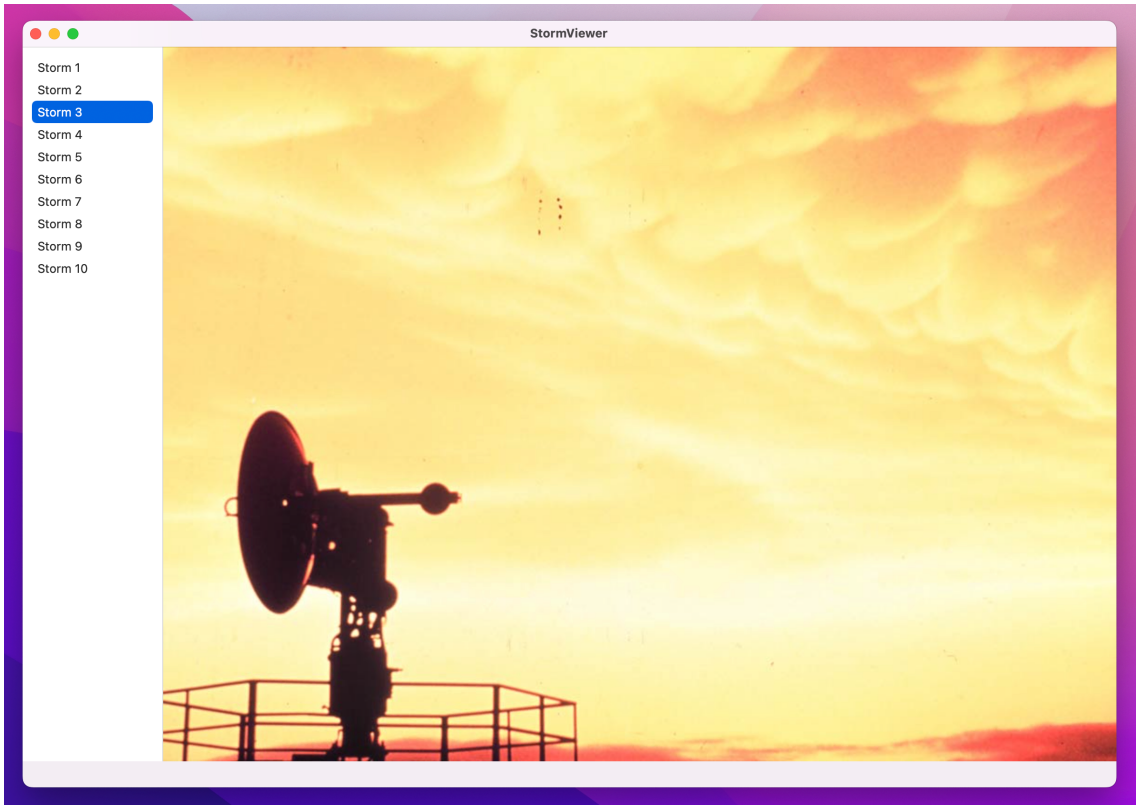
forcing the window to a large size is pretty bad too.

To fix this we need to add some extra modifiers to our views, starting with the **List**. Like I said, this has a flexible width and height by default, but we can override that to set a minimum width or even an exact width if we want.

In this situation I think an exact width works best, because we know how much space is needed. So, add a **frame()** modifier to the list, like this:

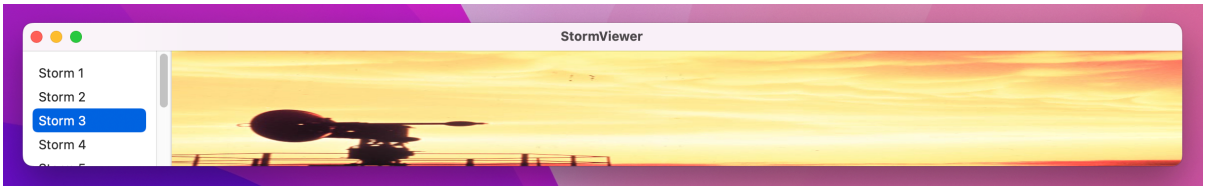
```
List(0..<10, selection: $selectedImage) { number in
  Text("Storm \(number + 1)")
}
.frame(width: 150)
```

Now the window size will still jump around as different images are shown – the last image is particularly wide, for example – but at least the list never disappears now.



Next we're going to make the image resizable, so it will take up as much space as there is currently available in the window rather than forcing it all to resize. This is done using the **resizable()** modifier for images, like this:

```
Image(String(selectedImage))
  .resizable()
```



That's fixed the window sizing problem, but if you look carefully you'll notice it introduces a new problem: the images get squashed now! The **resizable()** modifier tells SwiftUI that our image has a flexible width and height, allowing it to take up all the available space in our UI. However, that also means it will stretch to fit that space even when that means changing the aspect ratio of the image – it can now be really tall and thin, for example, even though the original image wasn't that shape.

To fix this we need *another* modifier. Remember when I said, "it's common to have many modifiers stacked up for a single view"? Well, here's a good example of that – we just stack up the modifiers to create the exact effect we want.

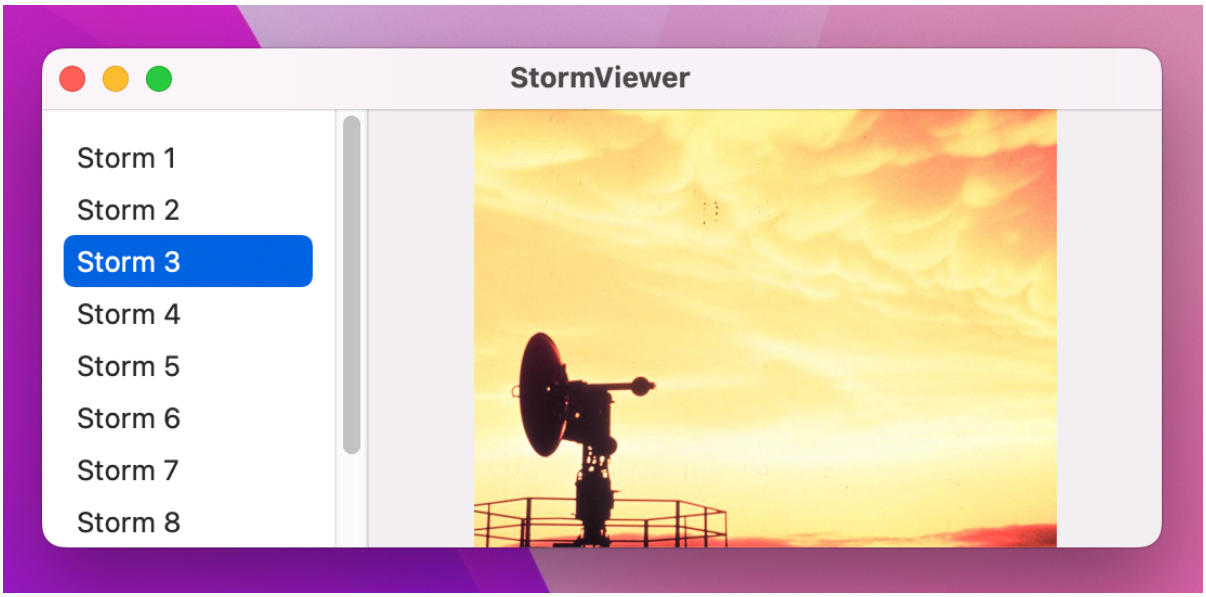
In this case the modifier is called **scaledToFit()**, which means the storm image will retain its original aspect ratio while also being resizable. In practice, this means most of the time there will be some blank space either above and below the image, or to its left and right, depending on the available space.

Change your image code to this:

```
Image(String(selectedImage))
  .resizable()
  .scaledToFit()
```

Press Cmd+R to run the app again and you should see it all behave much better – that was

pretty easy, I think!



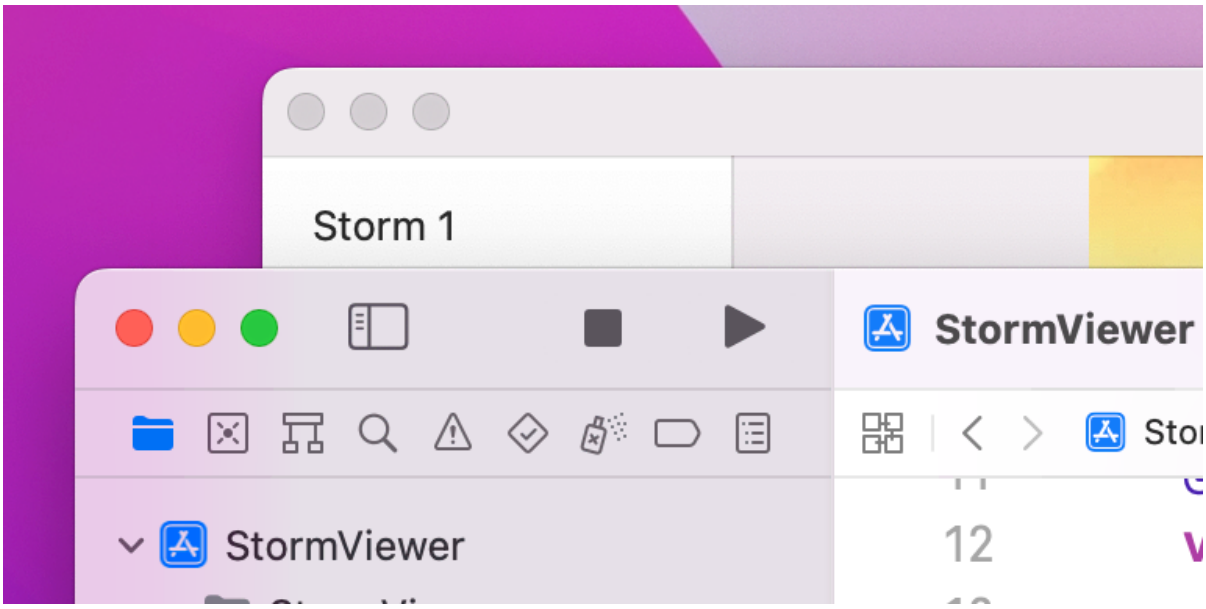
Finishing touches

This project is done and you could stop here if you wanted. Alternatively, we can make a few small tweaks that make the whole project feel a bit more polished.

First, you might notice that you can resize the window down to almost nothing at all, which is strange. It's common practice to enforce a sensible minimum size for your windows to avoid this problem, which in this case means attaching a minimum width and height for our split view – add this **frame()** to your **HSplitView**:

```
.frame(minWidth: 480, minHeight: 320)
```

Second, compare the window title bar in our app against the window title in Xcode, Finder, and other apps – do you notice how our title bar goes all the way to the left-hand edge, whereas in the other apps the list view on the left reaches the very top of the window?



We can get the identical behavior in our app by replacing our **HSplitView** with a more advanced view type called **NavigationSplitView**. This is one of two common ways of handling navigation in SwiftUI, and allows us to present two pieces of data at the same time: a sidebar of information on the left, and detail content on the right. Think of the way Notes and